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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,986	11/30/2001	Burn J. Lin	TS01-376	3471

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EXAMINER	
SAGAR, KRIPA	

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 01/07/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/002,986	LIN ET AL.	
	Examiner	Art Unit	
	Kripa Sagar	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 November 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-61* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-61* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *30 November 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *11/30/01* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970);and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. Claims 1-61 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-61 of U.S. Patent No. 6664011. Although the conflicting claims are not identical, they are not patentably distinct from each other. The sole difference between the instant claims and the corresponding claims of the patent is that the latter recites alternating phase shifting masks; these are a sub-set of the generic masks of the instant claims. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use masks of the instant claims with a reasonable expectation of success in executing the double exposure process in view of its success with a phase shift mask.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by US Pat.6514648 to Peng.

The claim recites a method of exposure. The first mask of the set comprises a main feature (first pattern) and a second pattern that prints images upon exposure. The exposed layer is developed and a second material layer is coated on top. A subsequent mask comprises a pattern analogous to the first or second pattern and is used in a second exposure corresponding to one of the patterns formed by the first exposure. The second exposure may preserve or eliminate one of the first-exposed patterns.

Peng teaches all the elements of the instant claim. A substrate with a first material layer is exposed with a first mask containing a first pattern and a second pattern. The patterns are developed. A second material layer is applied over the patterns. A second mask with a third pattern corresponding to the second pattern is used to expose the second material layer. The layer is developed to reveal the desired first pattern (5;44-67). The mask patterns may be any shape desired and thus would implicitly apply to contact holes (6;21-26). Peng teaches that it is well known in the art to use positive or negative resists [1;44-65]. Correspondingly brightfield and darkfield

masks may be used to expose or protect the resist in order to form a desired pattern (1;66-2;6).

5. Claim 1 is rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over US Pat.6337175 to Yamaguchi.

The claim recites a method of exposure. The first mask of the set comprises a main feature (first pattern) and a second pattern that prints images upon exposure. The exposed layer is developed and a second material layer is coated on top. A subsequent mask comprises a pattern analogous to the first or second pattern and is used in a second exposure corresponding to one of the patterns formed by the first exposure. The second exposure may preserve or eliminate one of the first-exposed patterns.

Yamaguchi teaches the elements of the instant claims. First mask (Fig.1) comprises first and second patterns which in this instance are similar. A substrate (1) carrying a photoresist (2) is exposed with the first mask and developed (Fig.2) to form the first and second patterns 2a. A second mask (5) comprises a third pattern corresponding to the second pattern to be eliminated (Fig.3). A second material layer (6) is coated on the first resist layer. The second mask is used to expose material layer 6 . The resist-carrying substrate is developed (Fig.4). The second exposure erases the second pattern in the areas as shown in Fig.4 leaving behind the first desired pattern 2b.

Yamaguchi does not explicitly teach patterning a contact hole; however the shape of the pattern on a mask may be designed as desired. The method of the instant process would assure successful imaging with other shapes such as contact holes.

6. Claim 1 is rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over US Pat. 5424154 to Borodovsky.

Borodovsky's invention (1;12-13;66) anticipates the elements of the instant claim as noted herein. It teaches a first mask 300 (Fig.3) with a first pattern 301b and a second pattern 310-313. The second patterns are assist features that maximize the exposure of the first pattern (1;43-3;25). A second mask 400 (Fig.4) carries a third pattern 410-413 that corresponds to the second pattern 310-313. The masks are sequentially exposed on a substrate and the resist is developed (4;2-42) to obtain the desired pattern shown in Fig.5. The third pattern is larger than the second pattern (4;21-30). The line spacing is maintained close to the width of the pattern to give 1:1 ratio which is within the limits of the instant range (6;55-7;3). The cross-sections of the first and second pattern are same, as are the periods. The image is formed on a photoresist (4;16-17). Borodovsky teaches the use of positive and negative photoresists. These may comprise the first material layer or the second material layer. The first and second pattern may be opaque or transparent. Correspondingly the third pattern used to delete the second pattern may be opaque or transparent (6;18-29 & 13;12-42). The photoresist is non-conducting. Proximal or overlapping features of the second pattern are merged (Fig.21, 12;29-35).

Borodovsky does not explicitly teach forming contact holes. Borodovsky's invention is generic to non-periodic patterns and inherently teaches the patterning of via's and contact holes. The shape of the pattern on a mask may be designed as

desired. The method of the instant process would assure successful imaging with other shapes such as contact holes.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 2-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Borodovsky in view of Peng.

Claims 2-19 recite the process steps for positive and negative resists and the use of corresponding brightfield and darkfield masks, pattern spacing and dimensions.

The teachings of Borodovsky have been discussed above. These include method of patterning positive and negative resists[cl.8,9]. These may comprise the first material layer or the second material layer. It teaches a method of patterning wherein the second layer is a positive resist or negative resist and exposing the second resist layer with a complementary mask . The first and second pattern may be opaque or transparent [cl.4-7]. The subsequent mask corresponding to the second pattern may be opaque or transparent (6;18-29 & 13;12-42). The feature spacing [cl.16] is maintained close to the width of the pattern to give 1:1 ratio which is within the limits of the instant range (6;55-7;3). Proximal or overlapping features [cl.18] of the second-exposure pattern are merged (Fig.21, 12;29-35).

Borodovsky does not explicitly teach forming contact holes [cl.2,3], or patterning an insulating material [cl.10-11]. It does not teach crosslinking or hardening the first layer[cl.12,13]. Borodovsky's invention is generic to non-periodic patterns and inherently teaches the patterning of via's and contact holes. Exposing and hardbaking the photoresist layer would necessarily crosslink and harden the layer. Borodovsky does not teach eliminating a feature [cl.19] on the second-exposure mask that conflicts with the first (desired) features. This would be obvious to one of ordinary skill in designing masks.

It is noted that photosensitive insulating layers [cl.10-11] would be patterned similar to any other photosensitive resist as taught by Borodovsky above. A non-photosensitive insulating layer is patterned with an overlaid photoresist and the process would be similar to Borodovsky's – the insulating layer not being critical to the exposure process.

Borodovsky does not teach the size or placement of the third or fourth pattern on the second-exposure mask [cl.14,1517].

Peng teaches the elements of claims 14,15,17. The second pattern is formed by adding a feature 13,15 on each side of the first-pattern feature 9 (Fig.2). The features are symmetrically placed about the first pattern feature and are the same size and provide periodicity to the first pattern. The placement of the features (distance) is based on numerous factors including their size, the density of (first) features on the mask and the exposure condition among others. The requirement of these assist features is that

they diffract sufficient energy to the main feature so as to minimize the proximity effect (6;21-34).

Note that Peng's and Borodovsky's inventions solve the same problem by similar techniques. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the assist patterns as taught by Peng in Borodovsky's masks and process because Peng teaches that one feature(on each side) is adequate for proximity-correction as compared to Borodovsky's two or more features to bring periodicity. This reduction increases the space available and decreases the margin for error as any skilled artisan would recognize.

9. Claims 26-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Borodovsky in view of Peng.

These claims recite mask sets for the exposure process. The sets include (a) a brightfield mask or (b) a darkfield mask designed for (c) positive tone resists or (d) negative tone resists. Additional design limitations include the size and spacing of the assist features on the masks.

Borodovsky teaches most of the elements of the instant claims as shown above. These include a darkfield trim mask with transparent patterns used with a positive resist (fig.4) and a brightfield mask used with a negative resist (13;12-42). The masks primarily expose the second pattern to eliminate them. Borodovsky teaches the spacing of the assist features from a main feature. It does not teach masking the first pattern or the second pattern to prevent their exposure in the second-exposure (i.e. a brightfield mask with a positive resist or a darkfield mask with a negative resist).

These would be obvious variations to an artisan and is well known in the art as shown by Peng. Peng teaches the characteristics of positive and negative tone resists (1;45-65) and that the exposure process may be used to mask parts of a substrate and expose parts of it (1;66-2;6). Peng teaches the size and spacing of the assist features as shown above.

Note that Peng's and Borodovsky's inventions solve the same problem by similar techniques. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the assist patterns as taught by Peng in Borodovsky's masks because Peng teaches that one feature(on each side) is adequate for proximity-correction as compared to Borodovsky's two or more features to bring periodicity. This reduction increases the space available and decreases the margin for error as any skilled artisan would recognize.

10. Claims 20-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Borodovsky in view of US Pat.6277543 to Furukawa et al.

The claims recite a method of forming contact holes using a single layer of dual-tone resist and exposure with two masks; the second exposure being a trim exposure.

The teachings of Borodovsky have been discussed above. Borodovsky uses a single layer of positive tone resist for two exposures with two masks; the second exposure is a trim exposure. It does not teach a dual-tone resist.

Furukawa teaches the use of a dual tone resist which forms positive- and negative-tone patterns at the extremes of irradiation intensity (i.e. very low or very high). Normal exposure results in patterns of both tones and a connected loop (unpatterned

area; see Figs.34-37). The connected loop may be trimmed by a second exposure with a second mask to form desired patterns (15;24-17;40). Furukawa teaches practical applications in fabricating semiconductor devices including bit-line contacts (figs.41-52). One step includes a first exposure of a dual-tone resist with a patterning mask followed by trimming the bit-lines with a trim mask (22;36-42).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a dual-tone resist as taught by Furukawa to form the contact holes of Borodovsky with the trimming process because Furukawa teaches the preferred method for forming DRAM devices thus results in smaller DRAM cells, and thus a greater density of DRAM cells, by using hybrid resist to form STI regions and bit lines with sub-critical dimensions (23;56-60).

11. Claims 2-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Peng in view of Borodovsky.

The teachings of Peng have been discussed above.

Peng teaches the concepts of positive and negative tone resists and masks used to expose or protect areas of interest. Peng does not explicitly teach the combination of masks and resists recited in claims 4-7. It does not teach the spacing between features on the masks [cl.16] . It does not teach merging the assist features [cl.18]. Peng does not teach eliminating conflicting features [cl.19] nor patterning an insulating material [cl.10-11]. It does not teach crosslinking or hardening the first layer[cl.12,13].

The teachings of Borodovsky have been discussed above. These include method of patterning positive and negative resists. These may comprise the first material layer

or the second material layer. It teaches a method of patterning wherein the second layer is a positive resist or negative resist and exposing the second resist layer with a complementary mask . The first and second pattern may be opaque or transparent [cl.4-7]. The subsequent mask corresponding to the second pattern may be opaque or transparent (6;18-29 & 13;12-42). The feature spacing [cl.16] is maintained close to the width of the pattern to give 1:1 ratio which is within the limits of the instant range (6;55-7;3). Proximal or overlapping features [cl.18] of the second-exposure pattern are merged (Fig.21, 12;29-35).

Exposing and hardbaking the photoresist layer would necessarily crosslink and harden the layer. Borodovsky does not teach eliminating a feature [cl.19] on the second-exposure mask that conflicts with the first (desired) features. This would be obvious to one of ordinary skill in designing masks.

Note that Peng discusses the application of positive and negative tone resists and the use of masks; Borodovsky provides explicit methods of successfully implementing it in Peng's process. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use complementary masks as taught by Borodovsky to form the patterns by Peng's method because it permits the use of pre-existing or available masks, exposure tools and tried resists without extensive re-design or experimentation.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kripa Sagar whose telephone number is 703-605-4427. The examiner can normally be reached on M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark F Huff can be reached on 703-308-2464. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

MH/ks

MARK F HUFF
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